Missouri Department of Natural Resources

# Biological Assessment Study

## Pearson Creek
## Greene County

## 2004 - 2005

**Prepared for:**

**Missouri Department of Natural Resources**
**Division of Environmental Quality**
**Water Protection Program**
**Water Pollution Control Branch**

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**Missouri Department of Natural Resources**
**Field Services Division**
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## TABLE OF CONTENTS

**Page**

## TABLES

**Page**

## FIGURES

**Page**



## ATTACHMENTS

## 1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MDNR**), Water Pollution Branch (**WPB**), the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate biological assessment of Pearson Creek in Greene County, Missouri. Samples were collected within a 1.5 mile segment of Pearson Creek that is currently on the 2002 303(d) list for unknown toxicity. Two sample stations, downstream of Jones Branch, located in the Springfield metropolitan area were assessed. One station was sampled in the fall 2004 sampling season and two stations were sampled during the spring 2005 sampling season. These stations were compared to biological criteria calculated from data collected from the biological criteria reference streams located in the Ozark/White Ecological Drainage Unit (**EDU**).

## 1.1 Study Area/Justification

Pearson Creek originates in eastern Greene County near the town of Strafford and flows to the southwest toward the city of Springfield where it discharges into the James River. Pearson Creek is listed in the Missouri Water Quality Standards (MDNR 2000) as a class "P" stream for a distance of 8.0 miles upstream from its confluence with the James River. Designated uses for Pearson Creek are "warm water aquatic life protection, human health/fish consumption, livestock and wildlife watering, and whole body contact recreation." The northern and eastern portion of the Pearson Creek watershed consists of primarily agricultural lands while the western and southern portions consist primarily of urban development from the city of Springfield.

## 1.2 Purpose

The purpose of the study is to determine if the Pearson Creek macroinvertebrate community is impaired. If Pearson Creek is impaired, a second objective is to determine possible sources of impairment and water quality parameters causing impairment.

## 1.3 Objectives

1) Determine if the macroinvertebrate community and water quality in Pearson Creek is impaired compared to data collected from biological criteria reference streams in the Ozark/White EDU.

2) Assess the habitat quality of Pearson Creek.

## 1.4 Tasks

1) Conduct a bioassessment of the macroinvertebrate community on Pearson Creek at one sampling station during the fall 2004 sampling season and two sampling stations during the spring 2005 sampling season.

2) Conduct a water quality assessment at the sampling stations to determine potential water quality impacts.

3) Collect a sediment sample in Jones Branch near its confluence with Pearson Creek to determine possible toxicity using Microtox.

4) Conduct a habitat assessment at the sampling stations to ensure comparability of aquatic habitats.

### 1.5 Null Hypotheses

1) The macroinvertebrate community will not differ between longitudinally separate reaches of Pearson Creek.

2) The macroinvertebrate community in Pearson Creek will not differ from data collected from biological criteria reference streams in the Ozark/White EDU.

## 2.0 Methods

Carl Wakefield and Brian Nodine of the Missouri Department of Natural Resources, Field Services Division, Environmental Services Program, Water Quality Monitoring Section conducted this study.

### 2.1 Study Timing

Macroinvertebrate and water quality samples were collected once at each sampling station during the fall and spring sampling seasons. The sediment sample collected in Jones Branch was collected during the spring sampling season. Fall sampling was conducted on September 29, 2004 and spring sampling and habitat assessments were conducted on March 22 and March 24, 2005.

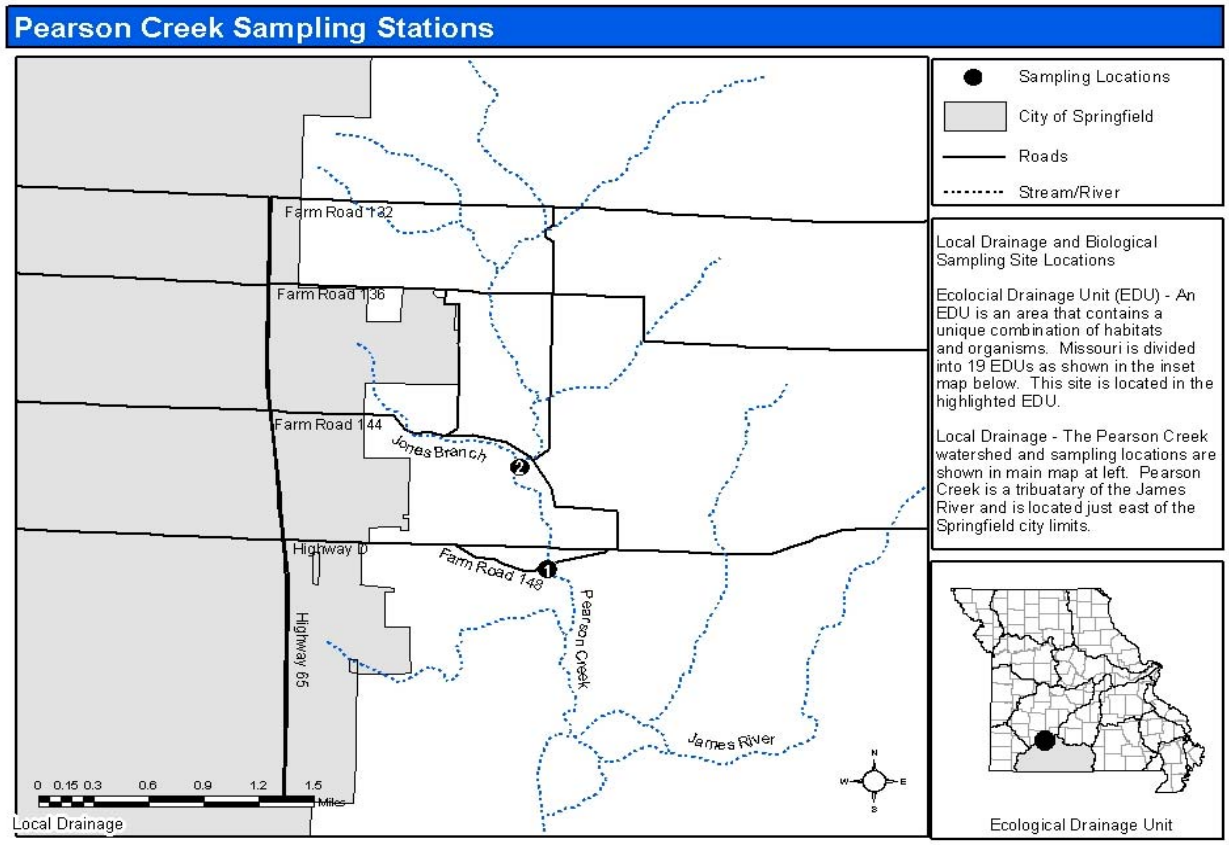
### 2.2 Station Descriptions

Figure 1 shows the location for the test stations on Pearson Creek and Table 1 provides legal descriptions and descriptive information for the test stations. For quality control purposes, duplicate samples were collected at station #2 during the spring sampling season.

Table 1
Station Number, Legal Location, and Descriptive Information for the Pearson Creek Bioassessment Study

| Station Number | Section, Township, Range | Description | County |
|---|---|---|---|
| Pearson Creek | NE ½ sec. 35, T. 29 N., R. 21 W. | Test-Downstream of Farm Road 144 and Jones Branch | Greene |
| Pearson Creek | NW ¼, sec. 26, T. 29 N., R. 21 W. | Test-Downstream of Farm Road 148 | Greene |

Figure 1: Map of Pearson Creek and Sampling Stations



### 2.2.1 Ecological Drainage Unit

An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. A map of the Ozark/White EDU is also included in Figure 1. All test stations are within this EDU. Table 2 compares the land cover percentages from the Ozark/White EDU and 14-digit Hydrologic Unit (**HU)** 11010002010005, which contains the Pearson Creek test stations. Land cover data were derived from Thematic Mapper satellite data from 2001 to 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). Grassland was the dominant land use followed by urban and forest in the Pearson Creek watershed. Forest was much lower and urban was much higher in the Pearson Creek watershed than values for the entire Ozark/White EDU (Table 2).

Table 2
Percent Land Cover

| Land Cover | 14-digit Hydrological Unit (HU) | Urban | Crops | Grassland | Forest | Swamp |
|---|---|---|---|---|---|---|
| Ozark White EDU | Multiple Hydrological Units | 3 | 1 | 37 | 53 | 0 |
| Pearson Creek #1 | 11010002010005 | 21 | 5 | 48 | 21 | 0 |
| Pearson Creek #2 | 11010002010005 | 21 | 5 | 48 | 21 | 0 |

## 2.3 Habitat Assessment

A standardized assessment procedure was followed as described for Riffle/Pool Habitat in the Stream Habitat Assessment Project Procedure (**SHAPP**) (2003a). The habitat assessment was conducted on all stations during the March 2005 sampling season.

## 2.4 Biological Assessment

Biological assessments consisted of macroinvertebrate collection and physicochemical sampling for the two sample periods.

### 2.4.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (2003b). Three standard habitats (flowing water over coarse substrate, depositional substrate in non-flowing water, and root-mat) were sampled at all locations.

Macroinvertebrate data were analyzed using two methods. The first analysis was using the four general biological metrics found in the SMSBPP. The four metrics used and found in the SMSBPP are: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**);

3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). The metric evaluations were determined by comparing Pearson Creek test stations on a seasonal basis to biological criteria calculated from data collected from reference streams in the Ozark/White EDU. Impairment of the Pearson Creek test stations was determined by calculating the Stream Condition Index (**SCI**), which is the sum of the four biological metric scores. The second analysis of the biological data was an evaluation of macroinvertebrate community percent composition of different macroinvertebrate groups.

### 2.4.2 Physicochemical Collection and Analysis

Physicochemical samples collected in fall 2004 and spring 2005 were: pH, temperature, conductivity, dissolved oxygen, discharge, turbidity, hardness, ammonia-N, nitrate/nitrite-N, Total Kjeldahl Nitrogen (TKN), chloride, and total phosphorus. Temperature, pH, conductivity, dissolved oxygen, and discharge analyses were conducted in the field. The WQMS measured turbidity in the WQMS Biology Laboratory. All other samples were delivered to the ESP Chemical Analysis Section (CAS) for analyses. All samples were collected per MDNR-FSS-001: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003e) and were kept on ice until they were delivered to the ESP laboratory.

Results of water quality analyses were compared to Water Quality Standards (MDNR 2000). The study reach of Pearson Creek is classified as a Class "P" stream and a general warm-water fishery (GWWF). Waters designated as GWWF "allow the maintenance of a wide variety of warm-water biota, including naturally reproducing populations of recreationally important fish species".

Two other criteria were included to identify limits. The first criterion was the reason for protection. In this case, values were identified for the "Protection of Aquatic Life". The second was the rate of exposure, such as chronic or acute exposure. This was important to determine limits for pollutants that could be tolerated by aquatic life over a period of time.

A sediment sample was collected in Jones Branch immediately upstream of its' confluence with Pearson Creek to determine possible toxicity of the benthic sediment. Toxicity of the sediment in Jones Branch could indicate a possible source of impairment to Pearson Creek. Microtox, a toxicity testing method, was used to test for toxicity in the sediment. Microtox uses a marine bacteria that emits light as the test organism. If the light output of the bacteria is reduced, then the sediment has some toxicity. For this sediment sample, the solid phase EC20 and EC50 tests were run for 30 minutes. An EC20 value is defined as the volume of material that is required to reduce the light output of the bacteria by 20 percent and the EC50 value is defined as the volume of material that is required to reduce the light output by 50 percent. Sediment samples that have toxicity will have lower EC20 and EC50 values than samples that do not have toxicity.

### 2.4.3 Discharge

Stream flow was measured using a Marsh-McBirney Flow Meter at each station and discharge was calculated as cubic feet per second (cfs). Methodology was in accordance with the standard

operating procedure MDNR-WQMS 113: Flow Measurement in Open Channels (MDNR 2003d).

## 2.5 Quality Control

Quality control was used as stated in the various MDNR Project Procedures and Standard Operating Procedures. Duplicate samples were collected and analyzed at sample station #2 during the spring 2005 sampling season for macroinvertebrate and physicochemical parameters. A random number of processed macroinvertebrate collections were also rechecked for missed specimens.

## 3.0 Analyses and Results

Four areas of interest are important to impact identification in Pearson Creek. These include a physical habitat assessment, biological assessment, physicochemical water analysis, and sediment toxicity.

## 3.1 Habitat Assessment

Table 3 provides habitat assessment scores for Pearson Creek test stations and Bull Creek, a biological criteria reference stream from the Ozark/White EDU. Data was collected in spring 2005 with Carl Wakefield and Brian Nodine performing the scoring. SHAPP guidance states that a test site that scores at least 75 percent of the total score of a reference station should fully support a biological community. Based on total habitat scores, Pearson Creek test stations were not habitat impaired.

Some habitat category scores in the SHAPP (epifaunal substrate, riffle quality, vegetative bank protection, and riparian zone width) scored in the poor or marginal category at one or both of the Pearson Creek test stations. This indicates potential limiting stream habitat factors that could affect the macroinvertebrate community (Table 4). At Pearson Creek #1, epifaunal substrate, bank vegetative protection, and riparian zone width scored in either the poor or marginal category. Epifaunal substrate, velocity/depth regime, riffle quality, vegetative bank protection, and the left bank riparian zone width scored in the poor or marginal category at Pearson Creek #2.

Table 3
Habitat Assessment Scores for Bull Creek, a Biological Criteria Reference Station, and the Test Stations on Pearson Creek, March 2004

| Reference Stream/Station | Habitat Score | Test Streams/Stations | Habitat Score | % of Reference |
|---|---|---|---|---|
| Bull Creek #1 | 147 | Pearson Creek #1 | 134 | 91 |
| | | Pearson Creek #2 | 131 | 89 |

Table 4
Predominant Category Habitat Values Estimated from Stream Habitat Assessments for Pearson Creek Test Stations and Biological Criteria Reference Station on Bull Creek

| | **Pearson Creek #1** | **Pearson Creek #2** | **Bull Creek #1** |
|---|---|---|---|
| **Stream Habitat Parameters** | | | |
| Epifaunal Substrate/Available Cover | III (18.5) | III (18.7) | II (38.5) |
| Embeddedness | I | I | I |
| Velocity/Depth Regime | I | III | I |
| Sediment Deposition | II (15.0) | I (4.6) | II (13.5) |
| Channel Flow Status | II | I | II |
| Channel Alteration | I | I | I |
| Riffle Quality | I | III | I |
| Bank Stability – Left Bank | I | I | I |
| Bank Stability – Right Bank | I | I | I |
| Vegetative Protection – Left Bank | IV (14.6) | IV (17.1) | IV (29.8) |
| Vegetative Protection – Right Bank | IV (41.0) | IV (34.0) | IV (17.5) |
| Riparian Zone Width – Left Bank | IV | IV | IV |
| Riparian Zone Width – Right Bank | III | I | I |

Mean values are listed in parentheses for habitat parameters in which a mean value was calculated. Habitat parameter categories ranged from I to IV with category I = optimal, category II = suboptimal, category III = marginal, and category IV = poor.

### 3.2 Biological Assessment

Macroinvertebrate data were evaluated by two methods. The first analysis used the general biological metrics in the SMSBPP. The second analysis of the biological data was an evaluation of macroinvertebrate community using percent composition of predominant macroinvertebrate taxa.

#### 3.2.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

The SMSBPP metric evaluation used numeric biological criteria within the Ozark/White EDU that were calculated from the ESP's Biological Criteria for Wadeable and Perennial Streams database. The criteria are listed for the fall and spring seasons in Tables 5 and 6.

Table 5
Biological Criteria Scores Calculated from Biological Criteria Streams in the Ozark/White EDU, Fall Season

| | Score = 5 | Score = 3 | Score = 1 |
|---|---|---|---|
| TR | >78 | 78-39 | 38-0 |
| EPTT | >26 | 26-13 | 12-0 |
| BI | <4.69 | 4.69-7.35 | 7.36-10 |
| SDI | >3.15 | 3.15-1.57 | 1.56-0 |

Table 6
Biological Criteria Scores Calculated from Biological Criteria Streams in the Ozark/White EDU, Spring Season

| | Score = 5 | Score = 3 | Score = 1 |
|---|---|---|---|
| TR | >93 | 93-46 | 45-0 |
| EPTT | >31 | 31-16 | 15-0 |
| BI | <4.49 | 4.49-7.24 | 7.25-10 |
| SDI | >3.23 | 3.23-1.61 | 1.60-0 |

The metric values and scores for Pearson Creek are presented in Table 7. Pearson Creek had partial sustainability (SCI score of 10) at all sample stations for both sampling seasons. All of the metrics scores were lower than biological criteria for the Ozark/White EDU. The Biotic Index (BI) was much higher, especially at test station #2, than reference conditions. Taxa richness (TR) was much lower than reference conditions during the spring sampling season. EPT taxa (EPTT) were very low (metric score of 1) for both sample seasons and less than half of the reference conditions in the Ozark/White EDU.

Table 7
Pearson Creek Metric Values and Scores, Using Biological Criteria Calculated from Biological Criteria Reference Streams in the Ozark/White EDU

**Fall 2004**

| Sample No./Station | TR | EPTT | BI | SI | T-Score | Sustain. |
|---|---|---|---|---|---|---|
| 04-49877 | | | | | | |
| Pearson Creek #1 Value | 71 | 12 | 5.62 | 2.88 | | |
| Pearson Creek #1 Score | 3 | 1 | 3 | 3 | 10 | Partial |

**Spring 2005**

| Sample No./Station | TR | EPTT | BI | SI | T-Score | Sustain. |
|---|---|---|---|---|---|---|
| 05-03034 | | | | | | |
| Pearson Creek #1 Value | 64 | 9 | 5.87 | 3.17 | | |
| Pearson Creek #1 Score | 3 | 1 | 3 | 3 | 10 | Partial |
| 05-03032 | | | | | | |
| Pearson Creek #2a Value | 69 | 15 | 6.61 | 2.49 | | |
| Pearson Creek #2a Score | 3 | 1 | 3 | 3 | 10 | Partial |
| 05-03033 | | | | | | |
| Pearson Creek #2b Value | 63 | 11 | 6.59 | 2.60 | | |
| Pearson Creek #2b Score | 3 | 1 | 3 | 3 | 10 | Partial |

### 3.2.2 Macroinvertebrate Percent and Community Composition

The macroinvertebrate community composition and biological metric values for samples collected during the fall 2004 and spring 2005 sampling seasons at the Pearson Creek test stations and Bull Creek, a biological criteria reference station, are presented in Tables 8 and 9.

Mean and standard deviation (SD) values for macroinvertebrate community composition and biological metric values for the Pearson Creek test stations and for the biological criteria reference stations in the Ozark/White EDU are presented in Tables 10 and 11.

Elmidae and Baetidae were the two most abundant macroinvertebrate families in the fall 2004 sampling season at Pearson Creek #1 (Table 8). Other families that were abundant included Chironomidae, Hyalellidae, and Hydropsychiidae. *Optioservus sandersoni*, *Hyalella azteca*, two baetid taxa (*Diphetor* and *Baetis*), and *Cheumatopsyche* were the five most abundant taxa found at Pearson Creek #1. The biological metric values were of a much lower quality at Pearson Creek #1 compared to values for the Ozark/White EDU biological criteria reference stations during the fall sampling period (Table 10). EPT taxa (EPTT) and percent EPT were two metrics that seemed to show the greatest impact at Pearson Creek #1, with much lower values for these metrics. The order Ephemeroptera showed the greatest decline for these metrics and mayfly families Heptageniidae and Caenidae were much lower at Pearson Creek #1 than at the Ozark/White EDU biological criteria reference stations.

Chironomidae was the most abundant macroinvertebrate family at the Pearson Creek test stations during the spring 2005 sampling season, ranging from 59.9 to 75.4 percent of taxa in the samples (Table 8). Other macroinvertebrate families that were common in the Pearson Creek samples were Elmidae, Baetidae, Asellidae, Planariidae, Crangonyctidae, and Simuliidae. Elmidae (primarily *Optioservus sandersoni*) and Baetidae (primarily *Diphetor* and *Baetis*) were much higher and Crangonyctidae (*Crangonyx*) was much lower at Pearson Creek #1 than at Pearson Creek #2 (Tables 8 and 9). Other taxa that were common at Pearson Creek test stations were the isopod *Lirceus* and chironomid taxa *Dicrotendipes, Cricotopus/Orthocladius*, and *Eukiefferiella*. *Dicrotendipes*, a tolerant chironomid that usually inhabits sediments in slow flowing waters, was much more abundant in the samples collected at Pearson Creek #2 than the sample collected at Pearson Creek #1. The biological metric values at the Pearson Creek test stations were of a much lower quality than at Bull Creek and the other biological criteria reference stations (Tables 8 and 11). EPT Taxa (EPTT) and percent EPT were much lower and biotic index was much higher at the Pearson Creek test stations. The values for percent mayflies and stoneflies were much lower at Pearson Creek test stations, with members of the families Heptageniidae, Ephemerellidae, Leuctridae, and Perlodidae having higher abundances at the Ozark/White EDU biological criteria reference streams.

Table 8
Macroinvertebrate Community Composition for Pearson Creek Test Stations and Bull Creek, a Biological Criteria Reference Station, during the Fall 2004 and Spring 2005 Sampling Seasons

| Variable-Station | Pearson Creek #1 | Pearson Creek #1 | Pearson Creek #2a | Pearson Creek #2b | Bull Creek #1 |
|---|---|---|---|---|---|
| Sample Date | 09/29/04 | 03/24/05 | 03/22/05 | 03/22/05 | 03/24/05 |
| Macro Sample Number | 04-49877 | 05-03034 | 05-03032 | 05-03033 | 05-03035 |
| Taxa Richness | 71 | 64 | 69 | 63 | 90 |
| EPT Taxa | 12 | 9 | 15 | 11 | 28 |
| Biotic Index | 5.62 | 5.87 | 6.61 | 6.59 | 4.28 |
| Shannon Diversity Index | 2.88 | 3.17 | 2.49 | 2.60 | 3.43 |
| % EPT | 25.39 | 8.1 | 3.2 | 3.4 | 44.8 |
| % Ephemeroptera | 18.2 | 7.0 | 2.0 | 2.3 | 28.5 |
| % Plecoptera | 0 | 0.1 | 0.3 | 0.1 | 14.8 |
| % Trichoptera | 7.1 | 0.9 | 0.8 | 0.9 | 1.5 |
| % Dominant Macroinvertebrate Families | | | | | |
| Elmidae | **24.7** | **7.2** | **1.8** | **1.8** | 1.4 |
| Baetidae | **14.5** | **6.3** | 1.4 | 1.2 | 2.0 |
| Chironomidae | **11.2** | **59.9** | **73.6** | **75.4** | **35.2** |
| Hyalellidae | **11.1** | 0.4 | 1.2 | 1.3 | 1.2 |
| Hydropsychidae | **6.0** | 0.4 | 0.1 | 0.1 | 0 |
| Asellidae | 5.6 | **10.6** | **9.7** | **6.6** | 0.8 |
| Planariidae | 3.8 | **3.1** | 1.4 | 0.9 | 0.5 |
| Crangonyctidae | 2.2 | 1.8 | **4.3** | **4.7** | 0.1 |
| Simuliidae | 2.9 | 1.3 | **1.5** | **1.6** | 0.2 |
| Heptagenidae | 2.3 | 0.4 | 0.1 | 0.1 | **11.0** |
| Ephemerellidae | 0 | 0 | 0 | 0 | **10.2** |
| Pleuroceridae | 1.1 | 0.4 | 0.1 | 0.1 | **7.8** |
| Leuctridae | 0 | 0 | 0 | 0 | **5.6** |

Values in bold indicate the five most abundant macroinvertebrate families for each sample.

Table 9
Macroinvertebrate Dominant Taxa Composition for Pearson Creek Test Stations and Bull Creek, a Biological Criteria Reference Station, during the Fall 2004 and Spring 2005 Sampling Seasons

| Variable-Station | Pearson Creek #1 | Pearson Creek #1 | Pearson Creek #2a | Pearson Creek #2b | Bull Creek #1 |
|---|---|---|---|---|---|
| Sample Date | 09/29/04 | 03/24/05 | 03/22/05 | 03/22/05 | 03/24/05 |
| Macro Sample Number | 04-49877 | 05-03034 | 05-03032 | 05-03033 | 05-03035 |
| % Dominant Macroinvertebrate Taxa | | | | | |
| *Optioservus sandersoni* | **23.5** | **6.6** | 1.2 | 1.2 | 0.1 |
| *Hyalella azteca* | **11.1** | 0.4 | 1.3 | 1.3 | 1.3 |
| *Diphetor* | **8.5** | 3.4 | 0.5 | 0.6 | 0 |
| *Baetis* | **6.1** | 2.0 | 0.4 | 0.7 | 0 |
| *Cheumatopsyche* | **5.9** | 0.4 | 0.1 | 0.1 | 0 |
| *Dicrotendipes* | 0 | 3.3 | **27.1** | **24.4** | 0.2 |
| *Cricotpus/Orthocladius* | 0 | **17.9** | **25.1** | **25.2** | 5.7 |
| *Lirceus* | 5.6 | **10.6** | **9.6** | **6.6** | 0.8 |
| *Eukiefferiella* | 0 | **9.8** | **7.7** | **8.6** | 0.4 |
| *Crangonyx* | 2.1 | 1.8 | **4.2** | **4.8** | 0 |
| *Paratendipes* | 1.3 | **6.7** | 2.4 | 1.3 | 0 |
| *Potthastia* | 0 | 0 | 0 | 0 | **14.3** |
| Heptageniidae (Immature Specimens) | 0 | 0 | 0 | 0 | **7.8** |
| *Elimia* | 1.2 | 0.4 | 0.1 | 0.1 | **7.8** |
| *Thienemannimyia* group | 0 | 0.4 | 1.4 | 1.2 | **6.8** |
| *Eurylophella bicolor* | 0 | 0 | 0 | 0 | **6.2** |

Values in bold indicate the five most abundant taxa for each sample.

Table 10
Macroinvertebrate Community Composition for the Pearson Creek Test Station and Ozark/White EDU Reference Stations for the Fall Sampling Season

| Variable-Station | Pearson Creek | Ozark/White EDU Bioref Streams |
|---|---|---|
| Sample Size (n) | 1 | 8 |
| Taxa Richness | 71 | 88.6 (16.4) |
| EPT Taxa | 12 | 28.5 (4.3) |
| Biotic Index | 5.6 | 4.4 (0.5) |
| Shannon Diversity Index | 2.9 | 3.3 (0.2) |
| % EPT | 25.4 | 42.7 (9.6) |
| % Ephemeroptera | 18.2 | 32.9 (10.2) |
| % Plecoptera | 0 | 0.4 (0.3) |
| % Trichoptera | 7.1 | 9.2 (4.4) |
| % Dominant Macroinvertebrate Families | | |
| Elmidae | **24.7** | **12.1 (9.1)** |
| Baetidae | **14.5** | 1.8 (1.2) |
| Chironomidae | **11.2** | **11.8 (4.4)** |
| Hyalellidae | **11.1** | 4.5 (4.2) |
| Hydropsychidae | **6.0** | 1.8 (3.3) |
| Heptageniidae | 2.3 | **11.2 (4.2)** |
| Psephenidae | 0.2 | **10.0 (11.2**) |
| Caenidae | 1.0 | **8.2 (6.7)** |

Ozark/White EDU values are listed as the mean with standard deviation in parenthesis. Values in bold are the five most abundant macroinvertebrate families for each group.

Table 11
Macroinvertebrate Community Composition Values, Mean (SD) for Pearson Creek Test Stations and Ozark/White EDU Reference Stations for the Spring Sampling Season

| Variable-Station | Pearson Creek | Ozark/White EDU |
|---|---|---|
| Sample Size (n) | 3 | 10 |
| Taxa Richness | 65.3 (3.2) | 100.2 (9.6) |
| EPT Taxa | 11.7 (3.1) | 33.6 (4.2) |
| Biotic Index | 6.4 (0.4) | 4.1 (0.7) |
| Shannon Diversity Index | 2.8 (0.4) | 3.4 (0.3) |
| % EPT | 4.9 (2.8) | 40.2 (7.4) |
| % Ephemeroptera | 3.8 (2.8) | 31.8 (6.4) |
| % Plecoptera | 0.2 (0.1) | 6.1 (4.6) |
| % Trichoptera | 0.9 (0.1) | 2.1 (0.8) |
| % Dominant Macroinvertebrate Families | | |
| Chironomidae | **69.6 (8.5)** | **29.7 (10.3)** |
| Asellidae | **9.0 (2.1)** | 0.6 (0.3) |
| Crangonyctidae | **3.6 (1.6)** | 0.1 (0.1) |
| Elmidae | **3.6 (3.1)** | **4.7 (5.0)** |
| Baetidae | **3.0 (2.9)** | 1.8 (2.0) |
| Pleuroceridae | 0.2 (0.2) | **12.8 (9.1)** |
| Heptageniidae | 0.2 (0.2) | **12.7 (8.4)** |
| Ephemerillidae | 0.0 (0.0) | **10.6 (5.9)** |

Values in bold are the five most abundant macroinvertebrate families for each group.

### 3.2.3 Physicochemical Water

Physicochemical results are arranged to demonstrate trends of certain variables that may identify a source for impacts to Pearson Creek. Results can be found in Table 12 for fall 2004 and spring 2005 samples. Results discussed in this section are for quality control, discharge, and nitrate + nitrite-N by season.

#### 3.2.3.1 Quality Control

Pearson Creek #2a and #2b of spring 2005 samples were duplicate water quality samples. Results from this duplicate were similar and indicated that sampling, transport, processing, and analyses of samples were consistent as well as precise.

#### 3.2.3.2 Discharge

Discharge during the fall 2004 sample season was 2.17 cfs at Pearson Creek #1. Discharge during the spring 2005 was 39.5 cfs at Pearson Creek #1 and 8.72 cfs at Pearson Creek #2. The difference in discharge between the two sampling stations was caused by a rain event that occurred in the Pearson Creek watershed after Pearson Creek #2 was sampled.

### 3.2.3.3 Nitrate + Nitrite-N

Nitrate + nitrite-N was elevated at the Pearson Creek test stations compared to data collected at the biological criteria reference streams in the Ozark/White EDU. Nitrate + nitrite-N was 1.32 mg/L at Pearson Creek #1 during the fall 2004 sampling season and ranged from 2.52 to 2.54 mg/L at Pearson Creek during the spring 2005 sampling season (Table 12). These values were much higher than the value of 0.42 mg/L at Bull Creek, a biological criteria reference stream station in the Ozark/White EDU. These values were also higher than nitrate + nitrite-N values from data collected from the Ozark/White EDU biological criteria reference streams which ranged from 0.14 to 0.79 mg/L. There are currently no water quality standards for nitrate + nitrite-N in the Missouri Water Quality Standards (MDNR 2000) for protection of aquatic life designation. The only water quality standard for nitrate + nitrite-N is 10.0 mg/L for the designation of drinking water supply.

Table 12
Physicochemical Variables for the Pearson Creek Study in Fall 2004 and Spring 2005

| Variable-Station | Pearson Creek #1, Test Fall 2004 | Pearson Creek #1, Test Spring 2005 | Pearson Creek #2a, Test Spring 2005 | Pearson Creek #2b, Test Spring 2005 | Bull Creek #1, Reference Spring 2005 |
|---|---|---|---|---|---|
| Physiochemical Sample Number | 04-11071 | 05-02874 | 05-02872 | 05-02873 | 05-02878 |
| Sample Date | 09/29/2004 | 03/24/2005 | 03/22/2005 | 03/22/2005 | 03/24/2005 |
| Sample Time | 1535 | 1110 | 1340 | 1355 | 1600 |
| pH (Units) | 7.84 | 7.76 | 8.02 | 7.87 | 7.78 |
| Temperature ($C^0$) | 18.5 | 11.0 | 12.1 | 12.0 | 9.20 |
| Conductivity (uS) | 488 | 424 | 470 | 458 | 302 |
| Dissolved $O_2$ | 10.4 | 11.3 | 12.3 | 11.5 | 10.7 |
| Discharge (cfs) | 2.17 | 39.50 | 8.72 | 8.72 | 303.00 |
| Turbidity (NTUs) | 2.62 | 5.10 | 11.5 | 4.80 | 1.74 |
| Ammonia-N | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Nitrate/Nitrite-N | **1.32** | **2.52** | **2.54** | **2.53** | 0.42 |
| Total Kjeldahl Nitrogen | 0.13 | 0.05 | 0.05 | 0.05 | 0.08 |
| Chloride | 25.5 | 16.5 | 20.8 | 19.8 | 5.16 |
| Total Phosphorus | 0.05 | 0.02 | 0.02 | 0.03 | 0.01 |

Units mg/L unless otherwise noted.

### 3.2.4 Sediment Sample

The sediment sample collected in Jones Branch on March 22, 2005 had an EC20 value of 10,800 mg/L and an EC50 value of >99,000 mg/L. The EC20 value indicated low levels of acute toxicity since the value was below the maximum concentration of 99,000 mg/L used in the test. A chronic toxicity test was not conducted, but the acute EC20 value indicated possible chronic toxicity, which might impact the macroinvertebrate community in Pearson Creek. The EC50 value did not indicate toxicity since it was higher than the greatest concentration used in the test.

## 4.0 Discussion

The discussion describes possible effects of stream habitat and physicochemical conditions on the biological metric scores and the macroinvertebrate community composition.

### 4.1 Habitat Assessment

Results of the stream habitat assessment during the spring 2005 sampling season are based on total habitat scores, which suggest that the Pearson Creek test stations should be comparable to Bull Creek, a biological criteria reference stream, in their ability to support a similar quality macroinvertebrate community. Even though some of the stream habitat parameters of the SHAPP (epifaunal substrate and vegetative protection) scored in the poor or marginal categories (Table 4), the overall condition of the habitat at the Pearson Creek test stations indicated that the macroinvertebrate community was not being impaired by poor habitat conditions.

### 4.2 Possible Effects of Land Use on the Macroinvertebrate Community

Grassland and urban areas make up a much larger percentage of the land use while forest makes up a much smaller percentage of land use in the Pearson Creek watershed compared to the land use of the entire Ozark/White EDU. The Springfield metropolitan area has dramatically increased in population in recent years, which has led to more development in the Pearson Creek watershed. The increased amount of impervious surfaces caused by development possibly could have altered the hydrology of Pearson Creek and increased runoff. The increased runoff could carry more contaminants, such as petroleum products, fertilizer, and pesticides that could lead to water quality problems that could affect the macroinvertebrate community.

### 4.3 Possible Water Quality Impacts

Macroinvertebrate data collected by City Utilities of Springfield from 1984 to 1992 found that EPTT were much higher in Pearson Creek upstream of Jones Branch (Youngsteadt, 1995). Samples collected in 1992 by City Utilities of Springfield also showed that TR and EPTT had declined significantly in Pearson Creek below Jones Branch compared to samples collected in 1964 and 1965.

Mayfly taxa *Isonychia bicolor*, *Heptagenia*, *Neochoroterpes*, *Habrophelboides*, *Paraleptophlebia*, *Ephemerella*, *Eurylophella*, and *Ephemera* were collected in Pearson Creek below Jones Branch in the 1970's (Witte, 1983), but were not collected in our Pearson Creek samples.

The MDNR macroinvertebrate samples collected from Pearson Creek scored poorly for all of the biological metrics in the SCI. The EPTT metric was very low, scoring only 1 out of 5 for that metric. The proportion of mayflies during the fall sampling season and the proportion of mayflies and stoneflies during the spring sampling season was greatly reduced compared to biological criteria reference streams in the Ozark/White EDU (Tables 10 and 11). The relative abundance of taxa in families Heptageniidae and Caenidae was much lower during the fall sampling season and the relative abundance of

Heptageniidae, Ephemerillidae, Leuctridae, and Perlodidae was much lower in the spring sampling season compared to the biological criteria reference streams in the Ozark/White EDU. In fact two of the families, Ephemerillidae and Leuctridae, were not collected in Pearson Creek at all.

The reduction of EPTT and lack of some EPT taxa that should be present indicates that contaminants entering the Pearson Creek watershed are possibly causing toxicity to macroinvertebrates. Water samples that were collected during this study had elevated levels of nitrate + nitrite-N, but this alone would most likely not account for the low EPTT values. Jones Branch has been hypothesized as a possible source of contamination and the sediment sample collected during the spring sampling season indicated low levels of toxicity for the acute EC20 test. A chronic toxicity test was not performed, but chronic toxicity is possible, based on the acute EC20 test. A previous sediment sample collected on August 23, 1999 in Jones Branch just downstream of Jones Spring showed elevated levels of aluminum, cadmium, iron, lead, zinc, mercury, and the pesticide chlordane. A study by USGS found low levels of the pesticide Diazinon and slightly elevated levels of zinc and aluminum in stormwater samples collected from August 1999 to August 2000 (Richards and Johnson, 2002). The same study found low levels of the pesticide chlordane and various polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) collected by semipermeable membrane devices (SPMDs) in Pearson Creek. The SPMDs from Pearson Creek also showed genotoxicity, which indicated possible bioaccumulation of contaminants in aquatic organisms. The results of the sediment sample collected in 1999 and the USGS study indicated numerous contaminants in the Pearson Creek watershed that could be impairing the macroinvertebrate community.

## 5.0 Conclusions

The Pearson Creek SCI scores indicate that the macroinvertebrate community is impaired compared to the Ozark/White biological criteria reference streams. Many different intolerant EPTT found previously in Pearson Creek below Jones Branch and in the Ozark/White biological criteria reference streams were not found in our Pearson Creek samples. The first null hypothesis, that all of the test stations would have a similar macroinvertebrate community, failed rejection. The second null hypothesis that test stations would not differ from the Ozark/White biological criteria reference streams was rejected. It is not known what is causing impairment even though we found elevated levels of nitrate + nitrite-N and low-level sediment toxicity in Jones Branch. It is likely caused by many different contaminants that enter the stream during stormwater events, which is supported by a USGS study finding low levels of pesticides, metals, PAHs, and VOCs in water and SPMD samples.

## 6.0 Recommendations

1. Conduct a more comprehensive macroinvertebrate study with sampling stations further upstream to determine if the macroinvertebrate community is impaired for the entire reach of Pearson Creek or just downstream of Jones Branch.

2. Conduct a comprehensive sediment and water quality study for the entire Pearson Creek watershed to determine possible sources of contaminants and toxicity that may be impairing the macroinvertebrate community downstream of Jones Branch.

3. Encourage best management practices that reduce the amount of contaminants such as fertilizer and pesticides that enter the Pearson Creek watershed.

## 7.0 Literature Cited

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John Ford, QAPP Project Manager, WPP

# Appendix A

Pearson Creek Bioassessment Study Macroinvertebrate Bench Sheets

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0449877], Station #1, Sample Date: 9/29/2004 4:00:00 PM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| "HYDRACARINA" | | | |
| Acarina | 42 | 62 | 26 |
| AMPHIPODA | | | |
| Crangonyx | 10 | 6 | 36 |
| Hyalella azteca | | | 272 |
| Stygobromus | | 2 | |
| ARHYNCHOBDELLIDA | | | |
| Erpobdellidae | 1 | -99 | |
| BRANCHIOBDELLIDA | | | |
| Branchiobdellida | 3 | 2 | 2 |
| COLEOPTERA | | | |
| Dubiraphia | | 6 | 10 |
| Ectopria nervosa | | 3 | |
| Optioservus sandersoni | 563 | 2 | 9 |
| Psephenus herricki | 1 | 1 | |
| Scirtes | | | 1 |
| Stenelmis | 4 | 6 | 5 |
| DECAPODA | | | |
| Orconectes neglectus | -99 | 2 | |
| Orconectes ozarkae | -99 | -99 | |
| DIPTERA | | | |
| Ablabesmyia | | 1 | |
| Antocha | 1 | | |
| Constempellina | | 1 | |
| Cricotopus bicinctus | | | 1 |
| Cricotopus/Orthocladius | | | 1 |
| Cryptochironomus | 2 | 3 | |
| Cryptotendipes | | 6 | |
| Hemerodromia | 1 | | |
| Hydrobaenus | | 1 | 1 |
| Micropsectra | 2 | | 6 |
| Microtendipes | | 1 | |
| Nilotanypus | | | 2 |
| Parametriocnemus | 2 | | |
| Paratanytarsus | | | 1 |
| Paratendipes | | 27 | 5 |
| Phaenopsectra | | | 1 |
| Polypedilum convictum grp | 9 | | 1 |
| Polypedilum illinoense grp | | | 3 |
| Polypedilum scalaenum grp | | 2 | |
| Procladius | | 9 | |
| Rheotanytarsus | 15 | 2 | 126 |
| Simulium | 64 | | 8 |
| Stempellinella | 8 | 2 | 10 |
| Stenochironomus | | 1 | |
| Stictochironomus | | 1 | |
| Tanytarsus | | 9 | 5 |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0449877], Station #1, Sample Date: 9/29/2004 4:00:00 PM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| Thienemanniella | 2 | | |
| Tvetenia | 2 | | |
| Zavrelimyia | | | 4 |
| EPHEMEROPTERA | | | |
| Baetis | 144 | | 5 |
| Caenis latipennis | | 13 | |
| Caenis punctata | | | 12 |
| Diphetor | 203 | | 4 |
| Leptophlebiidae | | 6 | 2 |
| Stenacron | 9 | 41 | |
| Stenonema pulchellum | 8 | | |
| HEMIPTERA | | | |
| Ranatra fusca | | | -99 |
| ISOPODA | | | |
| Lirceus | 79 | 5 | 54 |
| LIMNOPHILA | | | |
| Ancylidae | 4 | 14 | 6 |
| Ferrissia | | | 3 |
| Menetus | | | 2 |
| Physella | | | 1 |
| LUMBRICULIDA | | | |
| Lumbriculidae | 5 | -99 | |
| MESOGASTROPODA | | | |
| Elimia | 26 | 2 | 1 |
| ODONATA | | | |
| Argia | 1 | | |
| Calopteryx | | 1 | 8 |
| Enallagma | | | 3 |
| Hetaerina | | | 3 |
| TRICHOPTERA | | | |
| Cheumatopsyche | 142 | | 3 |
| Chimarra | 9 | | 2 |
| Hydropsyche | 1 | | 2 |
| Psychomyia | 2 | 1 | 1 |
| Triaenodes | | | 11 |
| TRICLADIDA | | | |
| Planariidae | 89 | | 6 |
| TUBIFICIDA | | | |
| Limnodrilus hoffmeisteri | 1 | 2 | 1 |
| Tubificidae | 7 | 69 | |
| VENEROIDEA | | | |
| Sphaeriidae | 1 | 3 | 2 |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0503032], Station #2a, Sample Date: 3/22/2005 11:00:00 AM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| "HYDRACARINA" | | | |
| Acarina | 1 | 3 | 4 |
| AMPHIPODA | | | |
| Crangonyx | 10 | 4 | 42 |
| Gammarus | | | 4 |
| Hyalella azteca | | 1 | 16 |
| Stygobromus | | 1 | |
| ARHYNCHOBDELLIDA | | | |
| Erpobdellidae | | -99 | -99 |
| BRANCHIOBDELLIDA | | | |
| Branchiobdellida | 2 | | 1 |
| COLEOPTERA | | | |
| Dubiraphia | | 2 | 3 |
| Ectopria nervosa | | | 1 |
| Hydroporus | | | 1 |
| Optioservus sandersoni | 14 | 1 | 1 |
| Peltodytes | | | 1 |
| Psephenus herricki | 1 | | |
| Scirtes | | | 1 |
| Stenelmis | 2 | | 1 |
| DECAPODA | | | |
| Orconectes neglectus | -99 | -99 | -99 |
| Orconectes ozarkae | | -99 | |
| Orconectes virilis | | | -99 |
| DIPTERA | | | |
| Ablabesmyia | | 1 | 2 |
| Ceratopogoninae | | 3 | 2 |
| Chironomus | | 2 | |
| Clinocera | 1 | | |
| Corynoneura | | | 1 |
| Cricotopus trifascia | 31 | 2 | |
| Cricotopus/Orthocladius | 258 | 44 | 29 |
| Dicrotendipes | 2 | 247 | 109 |
| Eukiefferiella | 97 | 2 | 3 |
| Micropsectra | 7 | 4 | 9 |
| Microtendipes | | | 1 |
| Paramerina | | | 3 |
| Parametriocnemus | 3 | | 1 |
| Paratanytarsus | | 1 | |
| Paratendipes | | 19 | 13 |
| Polypedilum convictum grp | 10 | 2 | |
| Rheotanytarsus | 17 | 3 | 2 |
| Simulium | 21 | | |
| Stempellina | | 1 | |
| Stempellinella | 1 | | 5 |
| Tanytarsus | | | 1 |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0503032], Station #2a, Sample Date: 3/22/2005 11:00:00 AM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| Thienemanniella | 19 | | 1 |
| Thienemannimyia grp. | 10 | 4 | 4 |
| Tipula | -99 | | |
| Tribelos | | 1 | |
| EPHEMEROPTERA | | | |
| Baetidae | 7 | | |
| Baetis | 4 | | 1 |
| Caenis latipennis | | | 6 |
| Diphetor | 7 | | |
| Stenacron | | 1 | 1 |
| Stenonema femoratum | | | -99 |
| ISOPODA | | | |
| Caecidotea (Blind & Unpigmented) | | 2 | |
| Lirceus | 66 | 2 | 58 |
| LIMNOPHILA | | | |
| Menetus | | | 2 |
| Planorbella | | | -99 |
| LUMBRICINA | | | |
| Lumbricidae | | -99 | |
| MESOGASTROPODA | | | |
| Elimia | | -99 | |
| ODONATA | | | |
| Calopteryx | | | 1 |
| PLECOPTERA | | | |
| Amphinemura | 2 | | |
| Perlesta | 2 | | |
| TRICHOPTERA | | | |
| Cheumatopsyche | | | 1 |
| Hydroptila | 3 | | |
| Ochrotrichia | | 1 | |
| Polycentropus | | | -99 |
| Psychomyia | 1 | | |
| Pycnopsyche | | | -99 |
| Triaenodes | | | 5 |
| TRICLADIDA | | | |
| Planariidae | 15 | | 4 |
| TUBIFICIDA | | | |
| Limnodrilus hoffmeisteri | | | 1 |
| Tubificidae | | 4 | 2 |
| VENEROIDEA | | | |
| Sphaeriidae | | 1 | 2 |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0503033], Station #2b, Sample Date: 3/22/2005 11:00:00 AM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| "HYDRACARINA" | | | |
| Acarina | 2 | 1 | 1 |
| AMPHIPODA | | | |
| Crangonyx | 9 | 2 | 47 |
| Gammarus | | -99 | 15 |
| Hyalella azteca | | | 16 |
| BRANCHIOBDELLIDA | | | |
| Branchiobdellida | | | 1 |
| COLEOPTERA | | | |
| Dubiraphia | | 1 | 7 |
| Hydroporus | | -99 | |
| Optioservus sandersoni | 13 | 1 | -99 |
| Psephenus herricki | | | 1 |
| DECAPODA | | | |
| Orconectes neglectus | | -99 | 1 |
| DIPTERA | | | |
| Ablabesmyia | | 1 | 4 |
| Ceratopogoninae | 2 | | 1 |
| Clinocera | 2 | 1 | |
| Corynoneura | 1 | | |
| Cricotopus bicinctus | 1 | | |
| Cricotopus trifascia | 44 | | 2 |
| Cricotopus/Orthocladius | 249 | 24 | 35 |
| Dicrotendipes | 3 | 197 | 98 |
| Eukiefferiella brevicalcar grp | 101 | 3 | 1 |
| Hydrobaenus | | 2 | 1 |
| Micropsectra | 1 | 5 | 4 |
| Microtendipes | 1 | | |
| Nanocladius | | | 1 |
| Parametriocnemus | 8 | | |
| Paratanytarsus | 2 | | |
| Paratendipes | | 12 | 4 |
| Phaenopsectra | 1 | | |
| Polypedilum convictum grp | 16 | 1 | |
| Polypedilum halterale grp | | 1 | |
| Polypedilum illinoense grp | 1 | | |
| Polypedilum scalaenum grp | 1 | | 1 |
| Procladius | | | 1 |
| Rheotanytarsus | 12 | | 8 |
| Simulium | 20 | | |
| Stempellina | | 1 | |
| Stempellinella | | 4 | 2 |
| Stictochironomus | | 1 | |
| Sympotthastia | | 1 | |
| Tanytarsus | 6 | | 1 |
| Thienemanniella | 19 | 1 | |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0503033], Station #2b, Sample Date: 3/22/2005 11:00:00 AM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| Thienemannimyia grp. | 10 | | 4 |
| Tipula | -99 | | -99 |
| Tvetenia bavarica grp | 15 | | 1 |
| EPHEMEROPTERA | | | |
| Baetis | 7 | | 1 |
| Caenis latipennis | | 3 | 9 |
| Diphetor | 7 | | |
| Leptophlebia | | -99 | 1 |
| Stenacron | 1 | -99 | |
| ISOPODA | | | |
| Caecidotea (Blind & Unpigmented) | | -99 | |
| Lirceus | 33 | 3 | 44 |
| LIMNOPHILA | | | |
| Ancylidae | | 1 | |
| LUMBRICINA | | | |
| Lumbricidae | 1 | -99 | |
| MESOGASTROPODA | | | |
| Elimia | | | 1 |
| ODONATA | | | |
| Calopteryx | | | -99 |
| PLECOPTERA | | | |
| Perlesta | 1 | | |
| TRICHOPTERA | | | |
| Cheumatopsyche | -99 | | |
| Hydroptila | 8 | | 1 |
| Oxyethira | | 1 | |
| Polycentropus | | -99 | 1 |
| Pycnopsyche | | | -99 |
| TRICLADIDA | | | |
| Planariidae | 11 | -99 | 1 |
| TUBIFICIDA | | | |
| Tubificidae | 1 | 3 | 11 |
| VENEROIDEA | | | |
| Sphaeriidae | | 1 | 1 |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0503034], Station #1, Sample Date: 3/24/2005 10:00:00 AM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| "HYDRACARINA" | | | |
| Acarina | 8 | 10 | |
| AMPHIPODA | | | |
| Crangonyx | 4 | 4 | 14 |
| Hyalella azteca | | 1 | 4 |
| Stygobromus | | 1 | |
| ARHYNCHOBDELLIDA | | | |
| Erpobdellidae | -99 | -99 | |
| BRANCHIOBDELLIDA | | | |
| Branchiobdellida | | 2 | 7 |
| COLEOPTERA | | | |
| Ectopria nervosa | | 1 | |
| Optioservus sandersoni | 75 | 5 | 1 |
| Stenelmis | 5 | | 3 |
| DECAPODA | | | |
| Orconectes neglectus | -99 | -99 | 1 |
| DIPTERA | | | |
| Brillia | 1 | 1 | 6 |
| Ceratopogoninae | | 17 | |
| Corynoneura | | | 2 |
| Cricotopus bicinctus | 7 | 2 | 12 |
| Cricotopus trifascia | 4 | | |
| Cricotopus/Orthocladius | 122 | 30 | 67 |
| Cryptotendipes | | 4 | |
| Diamesa | | 1 | |
| Dicrotendipes | 3 | 31 | 6 |
| Eukiefferiella brevicalcar grp | 78 | 12 | 30 |
| Hydrobaenus | 1 | 7 | |
| Labrundinia | | | 2 |
| Micropsectra | 8 | 1 | 6 |
| Microtendipes | | 1 | |
| Nilotanypus | | 1 | |
| Parakiefferiella | | 8 | 2 |
| Paramerina | | 2 | 1 |
| Parametriocnemus | 10 | | 1 |
| Paratendipes | | 80 | 2 |
| Polypedilum convictum grp | 13 | | 3 |
| Polypedilum illinoense grp | 1 | | 4 |
| Polypedilum scalaenum grp | 7 | 8 | 1 |
| Rheocricotopus | | | 1 |
| Rheotanytarsus | 12 | | 22 |
| Simulium | 13 | | 3 |
| Stempellina | | 2 | |
| Stempellinella | 2 | 3 | 2 |
| Stictochironomus | | 1 | |
| Sympotthastia | 1 | | 1 |

**Aquid Invertebrate Database Bench Sheet Report**

**Pearson Ck [0503034], Station #1, Sample Date: 3/24/2005 10:00:00 AM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| Tanytarsus | 3 | 7 | |
| Thienemanniella | 4 | 3 | 11 |
| Thienemannimyia grp. | 2 | | 3 |
| Tipula | 1 | | |
| Tipulidae | | 1 | |
| Tvetenia bavarica grp | 54 | | 9 |
| EPHEMEROPTERA | | | |
| Baetidae | 7 | 1 | 2 |
| Baetis | 22 | | 3 |
| Caenis latipennis | | 1 | 3 |
| Diphetor | 36 | | 6 |
| Stenacron | 4 | 1 | |
| ISOPODA | | | |
| Lirceus | 73 | 5 | 52 |
| LIMNOPHILA | | | |
| Physella | | 2 | |
| LUMBRICINA | | | |
| Lumbricidae | 3 | -99 | |
| MESOGASTROPODA | | | |
| Elimia | 5 | | |
| ODONATA | | | |
| Calopteryx | | | 1 |
| PLECOPTERA | | | |
| Perlesta | 1 | | |
| TRICHOPTERA | | | |
| Cheumatopsyche | 3 | 1 | 1 |
| Hydroptila | 3 | 2 | 1 |
| Psychomyia | 1 | | |
| TRICLADIDA | | | |
| Planariidae | 36 | 1 | 2 |
| TUBIFICIDA | | | |
| Enchytraeidae | | 1 | |
| Limnodrilus hoffmeisteri | 1 | 1 | |
| Tubificidae | 1 | 18 | |
| VENEROIDEA | | | |
| Sphaeriidae | 2 | 5 | |

**Aquid Invertebrate Database Bench Sheet Report**

**Bull Ck [0503035], Station #1, Sample Date: 3/24/2005 2:00:00 PM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| "HYDRACARINA" | | | |
| Acarina | | 1 | 2 |
| AMPHIPODA | | | |
| Hyalella azteca | | 4 | 11 |
| Stygobromus | | | 1 |
| BRANCHIOBDELLIDA | | | |
| Branchiobdellida | | 1 | 3 |
| COLEOPTERA | | | |
| Dubiraphia | 1 | 9 | 5 |
| Ectopria nervosa | | 2 | 2 |
| Helichus basalis | | | 1 |
| Hydraena | | 1 | |
| Hydroporus | | 1 | |
| Optioservus sandersoni | | 1 | |
| Peltodytes | | | 1 |
| Psephenus herricki | 3 | 15 | 9 |
| Stenelmis | 1 | | |
| DECAPODA | | | |
| Orconectes neglectus | -99 | -99 | 5 |
| DIPTERA | | | |
| Ablabesmyia | | 7 | |
| Ceratopogoninae | 1 | 7 | |
| Cladotanytarsus | | 1 | |
| Clinocera | 6 | 2 | |
| Corynoneura | | | 1 |
| Cricotopus/Orthocladius | 34 | 7 | 27 |
| Dicrotendipes | | 1 | 1 |
| Ephydridae | | 1 | |
| Eukiefferiella brevicalcar grp | 2 | | 3 |
| Glyptotendipes | | 1 | |
| Hexatoma | 1 | | |
| Labrundinia | | 2 | 4 |
| Micropsectra | 1 | | |
| Microtendipes | | 1 | |
| Ormosia | | | 2 |
| Orthocladius (Euorthocladius) | 5 | | 8 |
| Parakiefferiella | 1 | | |
| Parametriocnemus | 3 | | |
| Paratanytarsus | | 1 | 5 |
| Pilaria | | | 1 |
| Polypedilum convictum grp | 6 | | 1 |
| Polypedilum illinoense grp | 1 | 1 | 1 |
| Potthastia | 92 | 31 | 48 |
| Prosimulium | 2 | | |
| Rheocricotopus | 1 | | 1 |
| Simulium | 1 | | |

**Aquid Invertebrate Database Bench Sheet Report**

**Bull Ck [0503035], Station #1, Sample Date: 3/24/2005 2:00:00 PM**

**CS = Coarse, NF = Nonflow, RM = Rootmat**

**A value of -99 indicates that the species was found, but the exact number of species was not determined.**

| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| Stempellinella | 4 | 6 | |
| Sympotthastia | 2 | | 2 |
| Tabanus | 1 | | |
| Tanytarsus | 15 | 2 | 3 |
| Thienemanniella | | | 4 |
| Thienemannimyia grp. | 49 | 27 | 6 |
| Tipula | | | -99 |
| Zavrelimyia | | 4 | |
| EPHEMEROPTERA | | | |
| Acentrella | 19 | | 6 |
| Ameletus | | | 1 |
| Caenis latipennis | 4 | 5 | 1 |
| Ephemerella invaria | 36 | 3 | 10 |
| Eurylophella bicolor | 28 | 30 | 16 |
| Heptageniidae | 90 | 4 | |
| Leptophlebia | 2 | 9 | 14 |
| Leptophlebiidae | 1 | 4 | 5 |
| Leucrocuta | 8 | | |
| Paraleptophlebia | 1 | 6 | 5 |
| Siphlonurus | | 2 | 1 |
| Stenacron | 1 | | |
| Stenonema femoratum | 2 | 20 | 2 |
| Stenonema mediopunctatum | 6 | | |
| ISOPODA | | | |
| Lirceus | 2 | 4 | 4 |
| LIMNOPHILA | | | |
| Physella | 1 | | |
| LUMBRICINA | | | |
| Lumbricidae | 8 | 1 | |
| MEGALOPTERA | | | |
| Nigronia serricornis | | 1 | |
| MESOGASTROPODA | | | |
| Elimia | 3 | 43 | 48 |
| ODONATA | | | |
| Argia | 1 | | |
| Basiaeschna janata | | | -99 |
| Calopteryx | | | 2 |
| Enallagma | | | 1 |
| Gomphidae | | 1 | 1 |
| PLECOPTERA | | | |
| Acroneuria | 9 | 1 | 1 |
| Amphinemura | 2 | 1 | 10 |
| Chloroperlidae | 6 | | |
| Isoperla | 47 | | 3 |
| Perlesta | 7 | | 18 |
| Perlinella drymo | | 1 | -99 |
| Pteronarcys pictetii | 3 | | 1 |

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| ORDER: TAXA | CS | NF | RM |
|---|---|---|---|
| Zealeuctra | 49 | 19 | |
| TRICHOPTERA | | | |
| Agapetus | 2 | | |
| Helicopsyche | 2 | 1 | |
| Hydroptila | | 1 | |
| Polycentropus | 2 | 6 | 1 |
| Pycnopsyche | | 1 | |
| Triaenodes | | | 2 |
| TRICLADIDA | | | |
| Planariidae | 5 | 1 | |
| TUBIFICIDA | | | |
| Branchiura sowerbyi | | 1 | |
| Limnodrilus hoffmeisteri | | 1 | |
| Tubificidae | | 5 | |